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Nuclear reactions induced by macro-micro interactions in super-dense stars

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We know (Landau 1969, Ambert Sumyan 1968) that some baryon stars may have densities of the order of 10^{15} to 10^{16} gms per c.c. and higher. The distance between the centres of the baryons under such condition is 10^{-13} cm. The matter in this state can be considered to be a macroscopic system, in which quasi-particles exist as excitations of this system The minimum wave length of such excitations is

$$\lambda_{min} \sim 10^{-13}\text{cm}.$$

Therefore the corresponding maximum frequency is

$$\nu_{max} \sim \frac{v}{10^{-13}}, \quad i.e., \quad 10^{13}v$$

where v is the velocity of the wave

$$\epsilon_{max} = h\nu_{max} \sim 10^{-27} \times 10^{13}v,$$

$$i.e, \quad 10^{-14}v \quad \text{ergs},$$

$$i.e., \quad \epsilon_{max} \sim 10^{-8}v \text{ Mev}$$

Therefore the maximum possible energy of a quasi-particle is obtained by putting $v \sim 10^{10}$ cm per sec.

This is ~ 100 Mev

Thus there is the possibility of such quasi-particles inducing nuclear reactions by their interaction with a microparticle in the material of the star.

Of course the question is whether the quasi-particles can have such tremendous velocities under the conditions existing in the super-dense star. The answer is most probably affirmative if we take into consideration the fact that the forces between the micro-particles which hold them together to make the microscopic system (the super-dense star) are strong nuclear interactions.

One more interesting point is that the quasi-particles existing in ordinary macroscopic systems like gases, liquids and solids are connected with the electromagnetic forces between the particles of which the systems are made. But in the case of the quasi-particles which we have discussed above, the forces related to them are strong nuclear forces.

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